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Factsheet

HIGH SUGAR SWEET CORN

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There has been a significant increase in the demand for fresh market sweet corn in recent years due to the dramatic improvement in the sugar levels of new sweet corn cultivars (varieties). This is primarily due to the introduction of new "high sugar" cultivars. These higher sugar levels are the result of new genes that improve the corn's sweetness.

SWEETNESS GENES

Thirteen genes have been found that could eventually improve the sugar levels of sweet corn. The three major genes today that affect the sweetness of corn are: (1) the "sugary" gene (su); (2) the "Sugary Enhancer" gene (se); and (3) the "Supersweet" gene (SH_2).

Normal sweet corn cultivars that we have been growing for years contain the sugary **"su" gene.** These cultivars produce an average amount of sugar but the sugar changes to starch fairly quickly after harvest if their cob temperature isn't rapidly cooled.

Sugar enchanced corn cultivars contain the sugary enchancer **"se" gene**. These cultivars produce a higher amount of sugar than "su" types. Cultivars with the "se" gene also convert sugar to starch like normal sweet corn, but they will retain a sweet flavor longer after harvest because they have higher sugar levels to begin with. Cultivars containing the "se" gene tend to have thinner pericarps (skin over each kernel) and therefore must be handled more gently. This thin pericarp means they are more likely to be injured by a mechanical harvester. These cultivars contain the same types of complex sugars and therefore taste similar to normal sweet corn but they are sweeter and more tender. There are two distinct groups within the cultivars containing the "se" gene. Firstly there are the "Homozygous se" cultivars. They have higher sugar levels in 100% of their kernels. The other group includes cultivars containing the "Heterozygous se" gene. They have higher sugar levels in 25% of their kernels; the other 75% contain the normal su gene with lower sugar levels. So "Homozygous se" cultivars are usually sweeter than "Heterozygous se" cultivars.

Supersweet corn cultivars contain the **"SH_2" gene**. These cultivars do not convert sugar to starch readily and therefore stay sweet for a very long time after they reach harvest maturity. This allows more time for growers, wholesalers and retailers to market the corn. Also, since SH_2 types retain their sweetness longer in the consumer's home, it allows the family more time to enjoy their sweet corn. This does not mean "SH_2" types can be held indefinitely or that they don't need rapid cooling after harvest. "SH_2" cultivars are still living, breathing and burning up stored sugars. So as maturity advances, they burn up sugars which lowers their sweetness and their kernels develop thicker pericarps (skin), which means that they become more chewy.

THREE MAJOR SWEETNESS GENES

Gene	Type	% Sugar
su	Normal	9-16
se	sugar enhanced:	
	heterozygous 25% se	14-22
	homozygous 100% se	20-35
SH_2	Supersweet	28-44

Source: University of illinois

Now corn breeders are looking at gene combinations that will get even higher sugar levels. Combinations are also being tested to improve the germination of cultivars containing the SH_2 gene.

ISOLATION

Sweet corn is unique. Of all the fruits and vegetables we grow in Ontario, sweet corn is the only one where pollen from another cultivar can affect the quality (sugar level tenderness and kernel color) immediately. In all other crops the affect of pollen would not be apparent until the seed produced by that cross-pollination were grown. As a result, for cultivars of each gene type to reach their full potential, they must be grown in isolation from cultivars in another gene type. In some cases the affect can be very dramatic, with the corn at maturity actually taking on the flavor and texture of field corn.

Isolation is most critical with cultivars that contain the SH_2 gene. If they are pollinated by other gene types (su, se, field corn or Indian corn), they will revert to field corn with high starch and low sugar. Cultivars containing the se gene that are pollinated by normal su cultivars don't revert back to field corn, but their sugar levels will decline to normal su type levels.

Isolation by Gene Type **COB**

POLLEN	Normal	Homozygous se	Heterozgous se	Super Sweet
Normal	OK (N)	N	N	F
Homozygous se	N	OK	OK	F
Heterozgous se	N	OK	OK	F
Super Sweet	F	F	F	OK
Indian	F	F	F	F

F = the cobs will develop field corn flavor and texture
N = the flavor will revert back to normal (su) sweet corn
OK = reaches the full sugar potential for that gene type

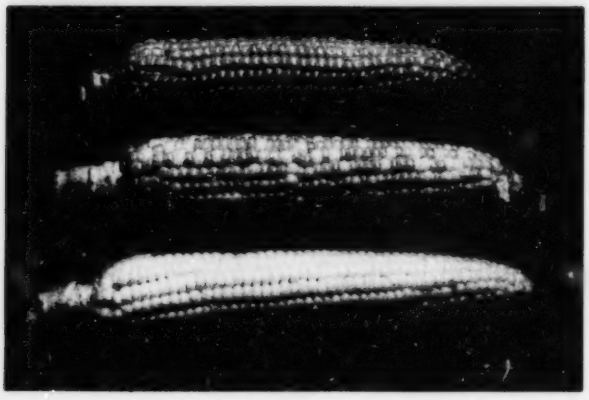

Figure 1: All 3 gene types su, se and SH_2 have yellow bicolor and white cultivars.

Isolation by Kernel Color

All three gene types (su, se and SH_2) have yellow, white and bicolor cultivars, and pollen from one color can affect the color of another. This means it is important to isolate plantings not only by gene type, but also by kernel color. Yellow and Indian corn kernel colors are particularly overpowering. Yellow cultivars will make a white cultivar bicolor and will reduce the number of white kernels in a bicolor. Likewise, bicolored cultivars produce some yellow kernels in white cultivars.

Indian corn pollen can also dramatically affect the appearance of all three types (yellow, white and bicolor) by causing black kernels to appear in their cobs.

Isolation by Kernel Color **COB**

POLLEN	Yellow	White	Bicolor
Yellow	OK	W+Y	Less W
White	OK	OK	OK
Bicolor 3:1	OK	W+Y	OK
Indian	Bl	Bl	Bl

Bl = black Y = yellow W = white
Bicolor 3:1= 75% yellow, 25% white

Cross-pollination is primarily a problem in the outside three or four rows of any planting. Further inside a planting there is so much pollen of the same cultivar that the affect of the unwanted pollen from another gene type is minimal.

Isolation can be attained in different ways.

1. Separate one gene type from another by at least 100 m (350 ft.).
2. Prevailing winds can carry unwanted pollen downwind. One hundred metres may not be enough. It will help to plant the more sensitive gene type upwind to ensure it is not cross-pollinated by another gene type.
3. Schedule plantings so that tasselling times are two weeks apart. This technique prevents cross-pollination without separating the gene types by 100 m.
4. If space is limiting and tasselling times cannot be separated by two weeks, separate one group from another by 15 m. Then treat the four outside rows of the downwind cultivar as buffer rows. The pollen from these four buffer rows will dilute the affect of the pollen from the other gene group upwind. These four buffer rows will be contaminated with foreign pollen and should not be marketed.

Improving Germination of High Sugar Cultivars

Emergence of sweet corn plantings are influenced by a number of factors including soil temperature, seed quality, soil moisture, depth of seeding and the gene type of the cultivar. We will look at these factors and their effect on emergence.

Soil Temperature

Soil temperature has a dramatic effect on the speed of germination and percentage seed emergence. Most seed companies will identify the cultivars which will tolerate colder soils.

Putting seed in soil that is too cold for germination means that they will lay dormant in the soil. This makes the seed more vulnerable to attach by insects and diseases. A good rule of thumb is that Normal (su) cultivars can tolerate the coolest soil temperatures of between 9-13°C (48-55°F). Sugar Enhanced (se) cultivars will give better plant stands if soils are in the 13-16°C (55-60°F) range. Supersweet (SH_2) cultivars generally prefers soils above 15°C (58°F).

DATE VS % EMERGENCE OF SH_2 SWEET CORN

Seeding Date		% Emergence
Cultivar A	- May 7	34
	- May 14	58
	- May 26	78
Cultivar B	- May 7	62
	- May 14	71
	- May 26	78
Cultivar C	- May 7	42
	- May 14	59
	- May 26	70

Note that the percentage of germination improves as soil warms up.

Source: Kemptville College of Agricultural Technology

Seed Quality

Once seed is damaged it becomes very susceptible to insect and disease attack. It is important to note that se, and particularly SH_2, cultivars are fragile and their seed requires gentle handling to prevent it from cracking before or during planting. This means laying the bags of seed down gently rather than throwing them.

Soil Moisture

Planting seed into moist soil is essential for germination. Otherwise, the seed will lay dormant. But most importantly planting seed into dry soil will put gaps in your harvest schedule.* The ideal way to ensure moisture with the seed is to have an irrigation system.

*For information on scheduling see OMAF Factsheet, *Scheduling Planting of Sweet Corn*, Agdex 253/22.

Depth of Seeding

Understandably an irrigation system is not always possibly. As an alternative, some growers try to ensure there is moisture with the seed by planting the seed deeper. Normal "su" and sugar enhanced "se" corns can generally tolerate deeper planting because the seed has more food reserves.

SH_2 cultivars have very little food reserves and therefore have trouble reaching the soil surface if seeded too deeply. Where possible, avoid planting SH_2 cultivars deeper than 2.5 cm (1 in.). If soil moisture is inadequate, it is best to irrigate the field to encourage rapid emergence rather than planting the seed too deeply.

DEPTH VS % EMERGENCE OF SWEET CORN

Gene Type	Seeding Depth	% Emergence	
		1988	1989
Normal	3.0 cm	89	85
	4.5 cm	78	82
	6.2 cm	81	65
Sugar enchanced (se)	3.0 cm	88	86
	4.5 cm	92	86
	6.2 cm	91	79
Supersweet (SH_2)	3.0 cm	64	58
	4.5 cm	50	47
	6.2 cm	42	31

The deeper the seed, the poorer the germination, particularly with SH_2 cultivars.

Source: Kemptville College of Agricultural Technology

SUMMARY

Sweet corn cultivars have improved greatly over the past few years and they will continue to get even better.

Many retailers are demanding the high sugar supersweet (SH_2) types because they have a much longer shelf life and reduce waste in the produce department. Today 90% of Florida's sweet corn production is the SH_2 type and other American states further north are following Florida's lead. This high sugar corn is imported into Ontario throughout spring and early summer, giving consumers a surprisingly good product. These new corn cultivars also give the consumer more time to enjoy their sweet corn at home.

Unfortunately, supersweet cultivars are proving to be more of a challenge to grow because of their:

- sensitivity to cold spring soils
- low food reserves in their seed
- fragile seed that cracks easily

Sweet corn should continue to be an expanding market for Ontario producers as consumers learn about the new high sugar sweet corn.

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